

10/539242

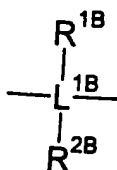
AMENDMENTS TO THE CLAIMS

2017 Filing PCT/PTO 16 JUN 2005

1. (original) A monocyclopentadienyl complex which comprises the structural feature of the formula  $(\text{Cp})(-\text{Z}-\text{A})_m\text{M}$  (I), where the variables have the following meanings:

Cp is a cyclopentadienyl system,

Z is a bridge between A and Cp of the formula,



where

$\text{L}^{1\text{B}}$  are each, independently of one another, carbon or silicon,

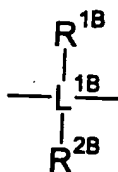
$\text{R}^{1\text{B}}, \text{R}^{2\text{B}}$  are each, independently of one another hydrogen,  $\text{C}_1\text{-C}_{20}$ -alkyl,  $\text{C}_2\text{-C}_{20}$ -alkenyl,  $\text{C}_6\text{-C}_{20}$ -aryl, alkylaryl having from 1 to 10 carbon atoms in the alkyl part and 6-20 carbon atoms in the aryl part or  $\text{SiR}^{3\text{B}}_3$ , where the organic radical  $\text{R}^{1\text{B}}$  and  $\text{R}^{2\text{B}}$  may also be substituted by halogens and the two radicals  $\text{R}^{1\text{B}}$  and  $\text{R}^{2\text{B}}$  and/or  $\text{R}^{1\text{B}}$  and  $\text{R}^{2\text{B}}$  and A may also be joined to form a five- or six-membered ring,

$\text{R}^{3\text{B}}$  are each, independently of one another, hydrogen,  $\text{C}_1\text{-C}_{20}$ -alkyl,  $\text{C}_2\text{-C}_{20}$ -alkenyl,  $\text{C}_6\text{-C}_{20}$ -aryl, alkylaryl having from 1 to 10 carbon atoms in the alkyl part and 6-20 carbon atoms in the aryl part and two radicals  $\text{R}^{3\text{B}}$  may also be joined to form a five- or six-membered ring,

- A is an unsubstituted, substituted or fused, five-membered heteroaromatic ring system,
- M is a metal selected from the group consisting of titanium in the oxidation state 3, vanadium, chromium, molybdenum and tungsten and
- m is 1, 2 or 3.

2. (original) A monocyclopentadienyl complex as claimed in claim 1 having the formula  $(\text{Cp})-(\text{-Z-A})_m\text{MX}_k$  (VI), where the variables have the following meanings:

- Cp is a cyclopentadienyl system,
- Z is a bridge between A and Cp of the formula,



where

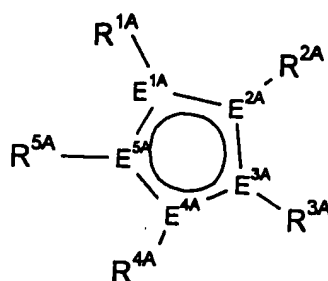
- $\text{L}^{1\text{B}}$  are each, independently of one another, carbon or silicon,
- $\text{R}^{1\text{B}}, \text{R}^{2\text{B}}$  are each, independently of one another hydrogen,  $\text{C}_1\text{-C}_{20}$ -alkyl,  $\text{C}_2\text{-C}_{20}$ -alkenyl,  $\text{C}_6\text{-C}_{20}$ -aryl, alkylaryl having from 1 to 10 carbon atoms in the alkyl part and 6-20 carbon atoms in the aryl part or  $\text{SiR}^{3\text{B}}_3$ , where the organic radical  $\text{R}^{1\text{B}}$  and  $\text{R}^{2\text{B}}$  may also be substituted by halogens and the two radicals  $\text{R}^{1\text{B}}$  and  $\text{R}^{2\text{B}}$  and/or  $\text{R}^{1\text{B}}$  and  $\text{R}^{2\text{B}}$  and A may also be joined to form a five- or six-

- membered ring,
- $R^{3B}$  are each, independently of one another, hydrogen,  $C_1$ - $C_{20}$ -alkyl,  $C_2$ - $C_{20}$ -alkenyl,  $C_6$ - $C_{20}$ -aryl, alkylaryl having from 1 to 10 carbon atoms in the alkyl part and 6-20 carbon atoms in the aryl part and two radicals  $R^{3B}$  may also be joined to form a five- or six-membered ring,
- A is an unsubstituted, substituted or fused, five-membered heteroaromatic ring system,
- M is a metal selected from the group consisting of titanium in the oxidation state 3, vanadium, chromium, molybdenum and tungsten,
- m is 1, 2 or 3,
- X are each, independently of one another, fluorine, chlorine, bromine, iodine, hydrogen,  $C_1$ - $C_{10}$ -alkyl,  $C_2$ - $C_{10}$ -alkenyl,  $C_6$ - $C_{20}$ -aryl, alkylaryl having 1-10 carbon atoms in the alkyl part and 6-20 carbon atoms in the aryl part,  $NR^1R^2$ ,  $OR^1$ ,  $SR^1$ ,  $SO_3R^1$ ,  $OC(O)R^1$ , CN, SCN,  $\beta$ -diketonate, CO,  $BF_4^-$ ,  $PF_6^-$  or a bulky noncoordinating anion,
- $R^1$ - $R^2$  are each, independently of one another, hydrogen,  $C_1$ - $C_{20}$ -alkyl,  $C_2$ - $C_{20}$ -alkenyl,  $C_6$ - $C_{20}$ -aryl, alkylaryl having from 1 to 10 carbon atoms in the alkyl part and 6-20 carbon atoms in the aryl part or  $SiR^3_3$ , where the organic radicals  $R^1$ - $R^2$  may also be substituted by halogens and two radicals  $R^1$ - $R^2$  may also be joined to form a five- or six-membered ring,
- $R^3$  are each, independently of one another, hydrogen,  $C_1$ - $C_{20}$ -alkyl,  $C_2$ - $C_{20}$ -alkenyl,  $C_6$ - $C_{20}$ -aryl, alkylaryl having from 1 to 10 carbon atoms in the alkyl part and 6-20

carbon atoms in the aryl part and two radicals  $R^3$  may also be joined to form a five- or six-membered ring and

k is 1, 2, or 3.

3. (currently amended) A ~~The~~ monocyclopentadienyl complex ~~as claimed in~~ of claim 1 or 2, wherein the cyclopentadienyl system Cp has the formula (II):

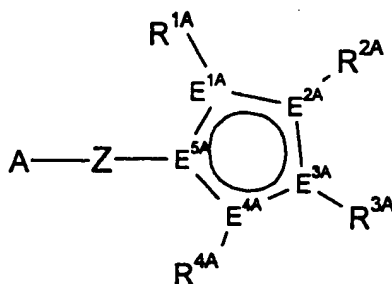


where the variables have the following meanings:

- $E^{1A}-E^{5A}$  are each carbon or not more than one  $E^{1A}$  to  $E^{5A}$  is phosphorus,
- $R^{1A}-R^{5A}$  are each, independently of one another, hydrogen,  $C_1$ - $C_{20}$ -alkyl,  $C_2$ - $C_{20}$ -alkenyl,  $C_6$ - $C_{20}$ -aryl, alkylaryl having from 1 to 10 carbon atoms in the alkyl part and 6-20 carbon atoms in the aryl part,  $NR^{6A}_2$ ,  $N(SiR^{6A}_3)_2$ ,  $OR^{6A}$ ,  $OSiR^{6A}_3$ ,  $SiR^{6A}_3$ ,  $BR^{6A}_2$ , where the organic radicals  $R^{1A}-R^{5A}$  may also be substituted by halogens and two vicinal radicals  $R^{1A}-R^{5A}$  may also be joined to form a five- or six-membered ring, and/or two vicinal radicals  $R^{1A}-R^{5A}$  are joined to form a heterocycle which contains at least one atom from the group consisting of N, P, O and S, with 1, 2 or 3 substituents  $R^{1A}-R^{5A}$  each being a -Z-A group and
- $R^{6A}$  are each, independently of one another, hydrogen,  $C_1$ - $C_{20}$ -alkyl,  $C_2$ - $C_{20}$ -

alkenyl, C<sub>6</sub>-C<sub>20</sub>-aryl, alkylaryl having from 1 to 10 carbon atoms in the alkyl part and 6-20 carbon atoms in the aryl part and two geminal radicals R<sup>6A</sup> may also be joined to form a five- or six-membered ring.

4. (currently amended) A The monocyclopentadienyl complex as claimed in any of claims 1 to 3 of claim 1, wherein the cyclopentadienyl system Cp together with -Z-A has the formula (IV):

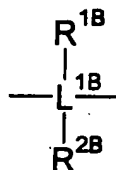


where the variables have the following meanings:

- E<sup>1A</sup>-E<sup>5A</sup> are each carbon or not more than one E<sup>1A</sup> to E<sup>5A</sup> is phosphorus,
- R<sup>1A</sup>-R<sup>4A</sup> are each, independently of one another, hydrogen, C<sub>1</sub>-C<sub>20</sub>-alkyl, C<sub>2</sub>-C<sub>20</sub>-alkenyl, C<sub>6</sub>-C<sub>20</sub>-aryl, alkylaryl having from 1 to 10 carbon atoms in the alkyl part and 6-20 carbon atoms in the aryl part, NR<sup>6A</sup><sub>2</sub>, N(SiR<sup>6A</sup><sub>3</sub>)<sub>2</sub>, OR<sup>6A</sup>, OSiR<sup>6A</sup><sub>3</sub>, SiR<sup>6A</sup><sub>3</sub>, where the organic radicals R<sup>1A</sup>-R<sup>4A</sup> may also be substituted by halogens and two vicinal radicals R<sup>1A</sup>-R<sup>4A</sup> may also be joined to form a five- or six-membered ring, and/or two vicinal radicals R<sup>1A</sup>-R<sup>4A</sup> are joined to form a heterocycle which contains at least one atom from the group consisting of N, P, O and S,
- R<sup>6A</sup> are each, independently of one another, hydrogen, C<sub>1</sub>-C<sub>20</sub>-alkyl, C<sub>2</sub>-C<sub>20</sub>-

alkenyl, C<sub>6</sub>-C<sub>20</sub>-aryl, alkylaryl having from 1 to 10 carbon atoms in the alkyl part and 6-20 carbon atoms in the aryl part and two geminal radicals R<sup>6A</sup> may also be joined to form a five- or six-membered ring,

Z is a bridge between A and Cp of the formula,



where

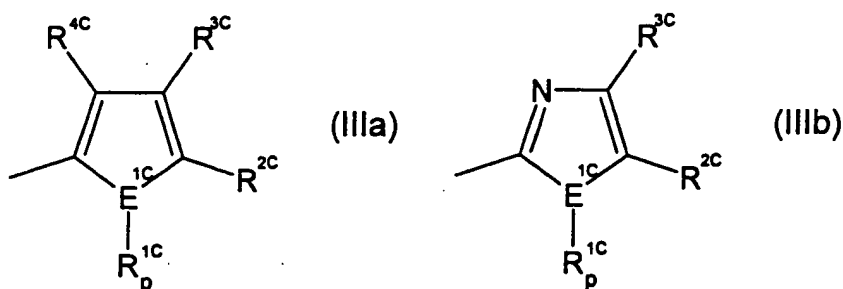
L<sup>1B</sup> are each, independently of one another, carbon or silicon,

R<sup>1B</sup>, R<sup>2B</sup> are each, independently of one another hydrogen, C<sub>1</sub>-C<sub>20</sub>-alkyl, C<sub>2</sub>-C<sub>20</sub>-alkenyl, C<sub>6</sub>-C<sub>20</sub>-aryl, alkylaryl having from 1 to 10 carbon atoms in the alkyl part and 6-20 carbon atoms in the aryl part or SiR<sup>3B</sup><sub>3</sub>, where the organic radical R<sup>1B</sup> and R<sup>2B</sup> may also be substituted by halogens and the two radicals R<sup>1B</sup> and R<sup>2B</sup> and/or R<sup>1B</sup> and R<sup>2B</sup> A may also be joined to form a five- or six-membered ring,

R<sup>3B</sup> are each, independently of one another hydrogen, C<sub>1</sub>-C<sub>20</sub>-alkyl, C<sub>2</sub>-C<sub>20</sub>-alkenyl, C<sub>6</sub>-C<sub>20</sub>-aryl or alkylaryl having from 1 to 10 carbon atoms in the alkyl part and 6-20 carbon atoms in the aryl part and two radicals R<sup>3B</sup> may also be joined to form a five- or six-membered ring,

A is an unsubstituted, substituted or fused, five-membered heteroaromatic ring system.

5. (currently amended) A The monocyclopentadienyl complex as claimed in any of claims 1 to 4 of claim 1, wherein A has the formula (IIIa) or (IIIb):



where

$E^{1C}$  is nitrogen, phosphorus, sulfur or oxygen,

$R^{1C}$ - $R^{4C}$  are each, independently of one another, hydrogen,  $C_1$ - $C_{20}$ -alkyl,  $C_2$ - $C_{20}$ -alkenyl,  $C_6$ - $C_{20}$ -aryl, alkylaryl having from 1 to 10 carbon atoms in the alkyl part and 6-20 carbon atoms in the aryl part or  $SiR^{5C}_3$ , where the organic radicals  $R^{1C}$ - $R^{4C}$  may also be substituted by halogens or nitrogen or further  $C_1$ - $C_{20}$ -alkyl groups,  $C_2$ - $C_{20}$ -alkenyl groups,  $C_6$ - $C_{20}$ -aryl groups, alkylaryl groups having from 1 to 10 carbon atoms in the alkyl part and 6-20 carbon atoms in the aryl part or  $SiR^{5C}_3$  and two vicinal radicals  $R^{1C}$ - $R^{4C}$  or the two radicals  $R^{1C}$  or  $R^{4C}$  and Z may also be joined to form a five- or six-membered ring,

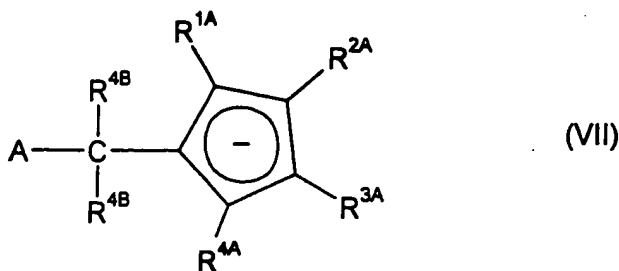
$R^{5C}$  are each, independently of one another, hydrogen,  $C_1$ - $C_{20}$ -alkyl,  $C_2$ - $C_{20}$ -alkenyl,  $C_6$ - $C_{20}$ -aryl or alkylaryl having from 1 to 10 carbon atoms in the alkyl part and 6-20 carbon atoms in the aryl part and two radicals  $R^{5C}$  may also be joined to form a five- or six-membered ring and

p is 0 when  $E^{1C}$  is sulfur or oxygen and is 1 when  $E^{1C}$  is nitrogen or

phosphorus.

6. (currently amended) A The monocyclopentadienyl complex as ~~claimed in any of claims 1 to 5 of claim 1~~, wherein L<sup>1B</sup> is carbon.
7. (currently amended) A The monocyclopentadienyl complex as ~~claimed in any of claims 1 to 6 of claim 1~~, wherein Z is -CH<sub>2</sub>-, C(CH<sub>3</sub>)<sub>2</sub>-, CH(C<sub>6</sub>H<sub>5</sub>)- or -C(C<sub>6</sub>H<sub>5</sub>)<sub>2</sub>-.
8. (currently amended) A catalyst system for olefin polymerization comprising
  - A) at least one monocyclopentadienyl complex as ~~claimed~~ defined in ~~any of claims 1 to 7 claim 1~~,
  - B) optionally an organic or inorganic support,
  - C) optionally one or more activating compounds,
  - D) optionally one or more catalysts suitable for olefin polymerization and
  - E) optionally one or more metal compounds containing a metal of group 1, 2 or 13 of the Periodic Table.
9. (original) A prepolymerized catalyst system as claimed in claim 8 and one or more linear C<sub>2</sub>-C<sub>10</sub>-1-alkenes polymerized onto it in a mass ratio of from 1:0.1 to 1:1 000, based on the catalyst system.
10. (currently amended) The use of a catalyst system as claimed in claim 8 ~~or 9~~ for the polymerization or copolymerization of olefins.

11. (currently amended) A process for preparing polyolefins by polymerization or copolymerization of olefins in the presence of a catalyst system as claimed in claim 8 or 9.
12. (original) A process for preparing cyclopentadienyl system anions of the formula (VII),



where the variables have the following meanings:

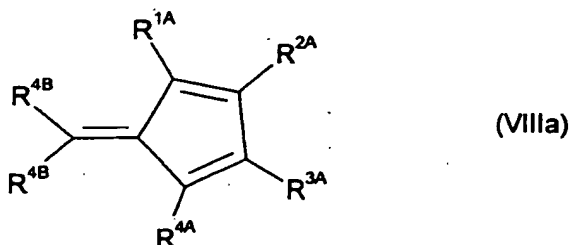
- $R^{1A}-R^{4A}$  are each, independently of one another, hydrogen  $C_1-C_{20}$ -alkyl,  $C_2-C_{20}$ -alkenyl  $C_6-C_{20}$ -aryl, alkylaryl having from 1 to 10 carbon atoms in the alkyl part and 6-20 carbon atoms in the aryl part,  $NR^{6A}_2$ ,  $N(SiR^{6A}_3)_2$ ,  $OR^{6A}$ ,  $OSiR^{6A}_3$ ,  $SiR^{6A}_3$  where the organic radicals  $R^{1A}-R^{4A}$  may also be substituted by halogens and two vicinal radicals  $R^{1A}-R^{4A}$  may also be joined to form a five- or six-membered ring, and/or two vicinal radicals  $R^{1A}-R^{4A}$  are joined to form a heterocycle which contains at least one atom from the group consisting of N, P, O and S,
- $R^{6A}$  are each, independently of one another, hydrogen,  $C_1-C_{20}$ -alkyl,  $C_2-C_{20}$ -alkenyl  $C_6-C_{20}$ -aryl, alkylaryl having from 1 to 10 carbon atoms in the alkyl part and 6-20 carbon atoms in the aryl part and two geminal radicals  $R^{6A}$  may also be joined to form a five- or six-membered ring,
- A is an unsubstituted, substituted or fused, heteroaromatic 5-membered ring system,
- $R^{4B}$  are each, independently of one another, hydrogen,  $C_1-C_{20}$ -alkyl,  $C_2-C_{20}$ -alkenyl,

$R^{4B}$  are each, independently of one another, hydrogen,  $C_1$ - $C_{20}$ -alkyl,  $C_2$ - $C_{20}$ -alkenyl,  $C_6$ - $C_{20}$ -aryl, alkylaryl having from 1 to 10 carbon atoms in the alkyl part and 6-20 carbon atoms in the aryl part or  $SiR^{3B}_3$ , where the organic radicals  $R^{4B}$  may also be substituted by halogens and two geminal or vicinal radicals  $R^{4B}$  may also be joined to form a five- or six-membered ring and

$R^{3B}$  are each, independently of one another, hydrogen,  $C_1$ - $C_{20}$ -alkyl,  $C_2$ - $C_{20}$ -alkenyl,  $C_6$ - $C_{20}$ -aryl or alkylaryl having from 1 to 10 carbon atoms in the alkyl part and 6-20 carbon atoms in the aryl part and two radicals  $R^{3B}$  may also be joined to form a five- or six-membered ring,

which comprises the step a) or a'), where,

in step a), an  $A^-$  anion is reacted with a fulvene of the formula (VIIIa)



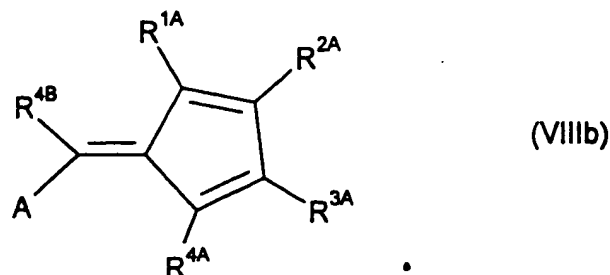
or,

in a step a'), an organometallic compound  $R^{4B}M^BX^b$ , where

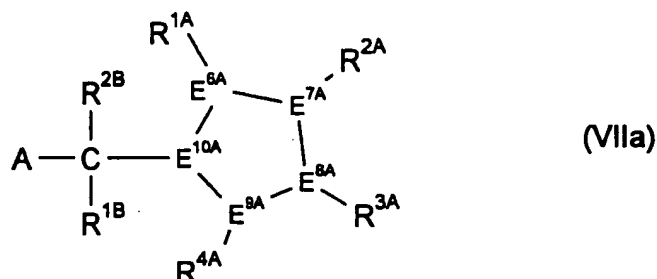
$M^B$  is a metal of group 1 or 2 of the Periodic Table of the Elements,

$X^B$  is halogen,  $C_1$ - $C_{10}$ -alkyl, alkoxy having from 1 to 20 carbon atoms in the alkyl part and/or from 6 to 20 carbon atoms in the aryl part, or  $R^{4B}$  and,

$b$  is 0 when  $M^B$  is a metal of group 1 of the Periodic Table of the Elements and is 1 when  $M^B$  is a metal of group 2 of the Periodic Table of the Elements, is reacted with a fulvene of the formula (VIIIb):



13. (original) A process for preparing cyclopentadiene systems of the formula (VIIa)



where the variables have the following meanings:

$E^{6A}-E^{10A}$  are each carbon, where in each case four adjacent  $E^{6A}-E^{10A}$  form a conjugated diene system and the remaining  $E^{6A}-E^{10A}$  additionally bears a hydrogen atom,

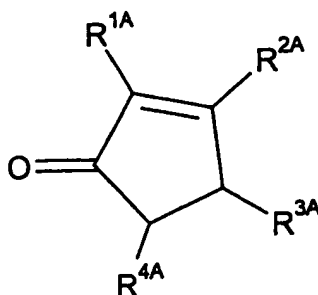
$R^{1A}-R^{4A}$  are each, independently of one another, hydrogen,  $C_1-C_{20}$ -alkyl,  $C_2-C_{20}$ -alkenyl,  $C_6-C_{20}$ -aryl, alkylaryl having from 1 to 10 carbon atoms in the alkyl part and 6-20 carbon atoms in the aryl part,  $NR^{6A}_2$ ,  $N(SiR^{6A}_3)_2$ ,  $OR^{6A}$ ,  $OSiR^{6A}_3$ ,  $SiR^{6A}_3$ , where the organic radicals  $R^{1A}-R^{4A}$  may also be substituted by halogens and two vicinal radicals  $R^{1A}-R^{4A}$  may also be joined to form a five- or six-membered ring, and/or two vicinal radicals  $R^{1A}-R^{4A}$  are joined to form a heterocycle which contains at least one atom from the group consisting of N, P, O and S,

$R^{6A}$  are each, independently of one another, hydrogen,  $C_1-C_{20}$ -alkyl,  $C_2-C_{20}$ -alkenyl,  $C_6-C_{20}$ -aryl, alkylaryl having from 1 to 10 carbon atoms in the

- alkyl part and 6-20 carbon atoms in the aryl part and two geminal radicals  $R^{6A}$  may also be joined to form a five- or six-membered ring,
- A is an unsubstituted, substituted or fused, heteroaromatic 5-membered ring system,
- $R^{1B}, R^{2B}$  are each, independently of one another, hydrogen,  $C_1$ - $C_{20}$ -alkyl,  $C_2$ - $C_{20}$ -alkenyl,  $C_6$ - $C_{20}$ -aryl, alkylaryl having from 1 to 10 carbon atoms in the alkyl part and 6-20 carbon atoms in the aryl part or  $SiR^{3B}_3$ , where the organic radicals  $R^{1B}$  and  $R^{2B}$  may also be substituted by halogens  $R^{1B}$  and  $R^{2B}$  and/or  $R^{1B}$  and A may also be joined to form a five-or six-membered ring,
- $R^{3B}$  are each, independently of one another, hydrogen,  $C_1$ - $C_{20}$ -alkyl  $C_2$ - $C_{20}$ -alkenyl,  $C_6$ - $C_{20}$ -aryl or alkylaryl having from 1 to 10 carbon atoms in the alkyl part and 6-20 carbon atoms in the aryl part and two radicals  $R^{3B}$  may also be joined to form a five- or six-membered ring,

which comprises the following step:

a'') reaction of an  $A-CR^{1B}R^{2B}$ -anion with a cyclopentenone system of the formula (IX)



(IX)